Revue suisse de Zoologie, vol. hors série: 611-615; août 1996

Aspects of Spider Research in China

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Aspects of spider research in China. - Research on spiders in China is closely associated with the need of agriculture. Since late 1970s, spider faunistic investigations in mountainous areas as well as on farmland have been undertaken in collaboration with plant protectors in many provinces. For assessing the role of spiders in the control of insect pests, studies of dominant species were carried out on their growth and development, longevity, courtship and mating, oviposition and progeny potential, feeding habit and predation on insect pests including functional response of them to prey population densities. In order to get more data for comparison, as usual, the spiders were reared and observed indoors as well as outdoors. In addition, the toxicity of pesticides to different dominant species of spiders have been tested. Up to date, Chinese arachnologists have published hundreds of papers on spider taxonomy and biology. Also, fourteen books dealing with spiders of China or provincial faunas have been published. Besides, three volumes of *Fauna Sinica* on spiders (Araneidae, Theridiidae, Thomisidae and Philodromidae, respectively) are being compiled.
China has a vast territory with a complex climate and topography. It is roughly estimated that there are at least 3,500 species of spiders in China warranting careful investigation.

Key-words: China - spiders - agriculture - fauna.

The first National Conference of Arachnology of China was held in Kunming, the capital of Yunnan, in June 1983 and the China Arachnological Society, as one of the 13 subsocieties of the China Zoological Society, was established in July 1986, marking the milestone in development of Arachnoloy in China. In the rnid-seventies, Chinese agriculture workers found that spiders were so abundant on the farmland that they presumably should play an important role in control of insect pests. Afterwards studies on spiders began to be carried out in many agricultural institutions. The utilization of spiders in biological control has brought about a great advance in researches on spiders not only in the aspects of biology but also in taxonomy. So the

Manuscript accepted 17.11.1995.
Proceedings of the XIIIth International Congress of Arachnology, Geneva, 3-8.IX.1995.

uprising of the research work on spiders in the past two decades is closely associated with the need in agriculture. Since then, "combat bugs with bugs" or "combat bugs with spiders" — this biological philosophy for the control of crop pests have been beginning to win widespread popularity among farmers, with the added bonus of cutting crop protection costs and insecticide pollution.

Comparing with insect parasites and other predators, spiders as a natural enemy of insect pests have the following advantages.

1. Spiders are abundant in the field. In general, the spider populations account for 60-80% of the total number of predators. Thus it means spiders are the most important component of predators.

2. Spiders are indiscriminate and voracious feeders. Spiders rarely reject any prey and they may suppress a wide range of pests. A tiny dwarf spider consumes about 2 planthoppers (*Nilaparvata lugens* Stål), daily. One median-sized spider consumes about 6 insects daily.

3. Spider usually appears in the field earlier than insect predators. For example, crab spider *Philodromus cespitum* (Walckenaer) in North China is found on the cotton seedling at least one month earlier than predacious insects. They capture cotton aphids at an earler stage to prevent the outbreak of aphids.

4. Under the circumstances of lacking food spider can survive for a long time. *Hylyphantes graminicola* (Sundevall) can live without food for 15–31 days and *Pardosa pseudoannulata* (Boesenberg & Strand), 56–116 days. When there are no insects for a certain period of time, spiders will not die with hunger. When the insect pests begin to reproduce, spiders would be activated for capturing them.

5. Spiders live in the same environment with the insect pests and they have high fecundity. *H. graminicola* produces 6–7 generations a year. Each generation produces about 10–15 egg sacs, each containing 40 eggs or so. *P. pseudoannulata* reproduces 2–3 generations a year. Each generation produces 4–7 egg sacs with about 120 eggs in each cocoon, sometimes even 200 eggs. They can live and multiply in the field for a long time. As for dwarf spiders, they can live 6–12 months, and the median-sized wolf spiders can live 1–2 years.

With the characteristics mentioned above spiders can be well used in biological control in addition to other natural enemies. Rearing and releasing are rather costly and failure may be due to bad weather. Most agriculture workers divert their attention to the protection of spiders.

Then what are the threats to affect the survival of spiders? One is farming activities, including ploughing, flooding, and crop harvesting, the other is insecticide application. Both can reduce the population of spiders in the field by 30–99%, the result could be the outbreak of pests afterwards due to the fact that the rates of growth and reproduction of spiders are lower than those of the pests

Different measures are adopted to preserve spiders in accordance with different culturing practices, such as: 1. Putting bunches of rice straw before ploughing or flooding and then taking them away to a field where spiders are needed. As usual, each such bunch may contain 400–700 spiders, some up to 1000 spiders. 2.

Inter-planting or arranging a "bridge-field" for spider transferring from one field to another one. 3. Leaving the border field not weeded to provide a place for the hiding of spiders. 4. Digging some holes near the farmland and covering them with straw as a shelter for spiders. Investigation showed that at first the number of pests might be equal to or higher than that of predators, but as time goes on the pests become fewer and fewer because of being eaten by their natural enemies. This is especially important for spiders living through the summer or winter. In addition, to tie bunches of straw on tree trunks is also useful for spider preservation.

Regarding the effect of application of insecticides, studies were carried out first to assess the role of spiders in the control of insect pests. Studies of every dominant species were carried out on their growth and development, longevity, courtship and mating, oviposition and potential of progeny multiplication, food habit and predation on insect pests including functional response of them to prey population densities. In order to get more data for comparison, as usual, the spiders were reared and examined under laboratory condition as well as at outdoor condition.

Agriculture workers have to estimate the ratio of spiders to the pests first. For example, in area of double cropping of rice in South China, if their population ratio (spider: hopper) in the early crop is 1:3–4, or 1:5–9 in the later crop (this depends on the dominant species of spiders present at the time), no outbreak of leafhopper (*Nephotettix cincticeps* (Uhler) and planthopper will occur. The agriculture technicians of the County Bureau of Agriculture or of Corporation have to collect and analyse the data from the plant protectors at the basic level, and then make the decision of using or not using insecticide, and if use, teach the method and amount of insecticide applied. If insecticide is necessary, its applications are usually confined to a part of acreage, to individual fields, or even to infested spots within a field.

This decision depends on the ratio of the natural enemies (especially spiders) to the pests, the growth and development of crop, etc. Emphasis is laid on whether in the key period of the coming 2–3 days spiders can depress the main pests below the threshold density. This is to say, although the ratio now is a bit higher, yet it will reduce to a point which we define or expect in several days later (it depends on the nutrition of crop), insecticide may be not used.

Selection of the correct insecticide and formulation are important not only for effective pest control but also for conservation of natural enemies. The toxicity of pesticides, to different dominant species of spiders has been tested by Chinese arachnologists. These studies are carried out not only on the different kinds of pesticides, but also on different formulations and methods of application. In a word, every effort has been made to minimize the adverse effects on spiders.

Along with the study on use of spiders as natural enemies to control insect pests the study on the taxonomy of spiders has also been developing. Beside our expedition to different provinces for collecting spiders, every year lots of specimens are sent from all regions of the country by agriculture workers for taxonomic identification. To meet the need from basic unit of the country at first we examined and identified the specimens collected from rice, wheat and cotton crops as well as from

fruit trees. So we started our work on the spiders which occur frequently in farmland or groves and are of more economic irnportance, such as families of Araneidae, Clubionidae, Lycosidae, Thomisidae, Tetragnathidae, Linyphiidae and Salticidae.

Although spiders were observed and reported in ancient China, arachnology as a branch of modern biology was introduced from the west in the nineteenth century. Early works dealing with Chinese spiders by foreign arachnologists can be listed as follows: Donoran (1798), Cantor (1842), Pryer (1868), Butler (1873), Koch, L. (1875), Simon (1880, 1885, 1886, 1888, 1895, 1901), Karsch (1881), Cambridge (1871, 1885), Lendl (1897), Pocock (1901), Strand (1907, 1909, 1910), Hogg (1912), Berland (1914), Chamberlin (1924), Gerhardt (1927), etc. Of them, Simon's paper (1880) on spiders from Beijing and its vicinity is most important. Some species (such as *Xysticus ephippiatus* Simon) described by him in the paper are very common in the fields.

The first Chinese zoologist who reported spiders was Prof. PING, C. In his papers dealing with the faunas of Nanking (1931) and of lower Iangtze in 1932, he noted about 33 genera of spiders in the city of Nanking and its suburbs. Though not an arachnologist he identified and listed some specific names of spiders correctly then, such as *Agelena labyrinthica* (Clerck), *Lycosa pseudoannulata*, *Scytodes thoracica* (Latreille), *Uroctea compactilis* L. Koch, *Oxyopes sertatus* L. Koch, and *Nephila clavata* L. Koch, etc. The first reports on spiders by Chinese arachnologists were not appeared until the year of 1963. Prof. WANG, F.Z. & ZHU, C.D. published 4 papers on spiders in the J. of Jilin Medical University.

Due to the need of agriculture as mentioned above, some zoologists turned their research topics to Araneae. In 1976, Song, D.X., Huang, Q.L., Feng, Z.Q. & Wang, H.Q., first noted some tetragnathids from the rice field of Zhejiang Province. After that, a new period in arachnology of China started. Up to date, Chinese arachnologists put out hundreds of papers on taxonomy, biology and spermatogenesis in spiders. Some of them were coauthored with American, German, Japanese and Korean colleagues. Also, fourteen books of spiders or provincial faunas have been published, namely: "Farmland Spiders" (Writing Group of "Farmland Spiders", 1980), "Protection and Utilizaton of Spiders in the Rice Fields" (WANG, H.Q., 1981), "The Spiders from Agricultural Regions of China" (SONG, D.X., 1987), "The Chinese Spiders Collected from the Fields and the Forests" (HU, J.L., 1984), "Spiders in the Cotton Fields in China" (ZHAO, J.Z., 1993), "Spiders in China, One Hundred New and Newly Records Species of the Families Araneidae and Agelenidae (Arachnida: Araneae)" (YIN, C.M., WANG, J.F., XIE, L.P. & PENG, X.J., 1990), "Salticids in China (Arachnida: Araneae)" (PENG, X.J., XIE, L.P. & PENG, X.J., 1993); "Spiders from Agricultural Regions of Xinjiang Ugygur Autonomous Region, China" (HU, J.L. & WU, W.G., 1989), "The Sichuan Farmland Spiders in China" (CHEN, X.E. & GAO, J.C., 1990), "Spiders from Farmland of Shaanxi, China" (GUO, J.F., 1985), "Araneae, Fauna of Zhejiang Province" (CHEN, Z.F. & ZHANG, Z.H., 1991), "Spiders from Farmland of Shanxi, China" (ZHU, M.S. & SHI, J.G., 1983); "Spiders from Farmland of Hebei, China" (ZHANG, W.S., 1987), "The Spiders Collected from the Fields and

Forests of Xizang Autonomous Region, China" (Hu, J.L. & Li, A.H., 1987). Besides, three volumes of *Fauna Sinica* on spiders (Araneidae, Theridiidae, Thomisidae and Philodromidae, respectively) are being compiled.

At present, most researches have been carried out by the following units: Hubei University in Wuhan, Hubei Province (biology), Institute of Zoology in Beijing (systematics), Hunan Normal University in Changsha, Hunan Province (systematics and biology), Hebei Teachers University in Shijiazhuanmg, Hebei Province (systematics), and Dr Norman Bethune University of Medical Science (former Jilin Medical University) in Changchun, Jilin Province (systematics). China Arachnological Society is now attached to the Hubei University. Plenary meeting is organized biennially by the society and a publication of *Acta Arachnologica Sinica* is issued from 1992, semiannually.

China is a vast country with complex topogeography and climate. It crosses frigid, temperate and tropical zones from north to south. Plateaux and high mountains occupy over 50 percent of land. Biogeophically, China is situated in both the Palaearctic and Oriental Realms. During the late Tertiary period, most regions had not been effected by glaciation, thus the fauna and flora is characterized by having many endemic and relic species. Therefore, it is considered internationally that China is one of the megadiversity countries in the world, where the number of species makes up about one tenth of the total number of species of the world. It is hard to say exactly how many species of spiders there are in China. But it may be roughly estimated that there are at least 3,500 species. Considering most species threatened by deforestation, habitat change, indiscriminate use of pesticides and other human impacts, it is urgent to organize large-scale surveys on China's fauna of Araneae, especially in provinces like Yunnan and Hainan. In order to keep the work on spiders flourishing, more funds, manpower and international collaboration are needed.

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